SUPERFUND RESPONSE ACTION PRIORITY PANEL REVIEW FORM

Date Form Completed: 02/06/2015

General Site Information

Region:	Region 4	City:	Atlanta	State:	GA
CERCLIS EPA ID:	NCN000409895		CERCLIS Site Name:	Ore Knob Mine Site	
NPL Status: (P/F/D)	Final		Year Listed to NPL:	09/23/09	

Brief Site Description: *(Site Type, Current and Future Land Use, General Site Contaminant and Media Info, Site Area and Location information.)*

Site Type: Ore Knob Mine is a former hard rock copper mine. Ore Knob was first mined for copper intermittently from 1855 to 1883 and again from 1957 to 1962. All mining was conducted underground through shafts and adits driven along the linear ore body. The workings, which extend for a horizontal distance of at least 4,000 feet and vertical distance of more than 1,000 feet are at least partly flooded with ground water.

Current and Future Land Use: Land in the immediate vicinity of the site is used for dispersed residences, mixed small scale agriculture, silviculture and Christmas tree farms. The Ore Knob area includes dispersed single family residences, several of which are located near or adjacent to former mine workings and ore processing areas, and mixed small scale agriculture and forestry operations.

General Site Contaminant and Media Info: Site investigations have identified contamination in surface water, ground water, sediment and soil. Contamination resulted from historic mining practices. Acid mine drainage and metals from prior site mining operations have contaminated **private drinking water wells** via ground water and surface water. Impacted streams and rivers include: a 1.5-mile length of Ore Knob Branch, a 2.25-mile length of Little Peak Creek, about 2.9 miles of Peak Creek, from its merging point with Ore Knob Branch to its merging point with South Fork New River, South Fork New River for some unknown distance downstream of Peak Creek. **Contaminated ground water is the primary threat to public health.** Other site contamination primarily poses a threat to the environment.

Site Area and Location information: The site is located in Ashe County, North Carolina about 12 miles south of the Virginia state line, 10 miles east of the town of West Jefferson, and 30 miles north of the city of Boone. The site lies within the watershed of South Fork New River in the Blue Ridge Province of the Appalachian Mountains. The site lies near the crest of Ore Knob and in nearby drainages, with elevations approximately 3,000 feet above mean sea level.

General Project Information

Type of Action:	Fund Lead Non-time Critical Removal Action	Site Charging SSID:	A4ND
Operable Unit:	01	CERCLIS Action RAT Code:	CO01

Is this the final action for the site that will result in a site construction completion?	☐ Yes	☒ No
Will implementation of this action result in the Environmental Indicator for Human Exposure being brought under control?	☒ Yes	☐ No

Response Action Summary

Describe briefly site activities conducted in the past or currently underway:

From 2008 to 2011, an EPA time critical removal action stabilized the dam at the main tailings impoundment containing an estimated 720,000 cubic yards of tailings. The action covered, vegetated and re-contoured the surface of the tailings to reduce erosion and routed surface water around the material via an engineered 100-year flood channel.

During the 2007 ESI, seven potable water sources were sampled including a well sampled as background. In April 2010, it was determined that several wells exceeded health-based levels for cobalt and manganese. In April 2010 in coordination with the groundwater investigation, EPA initiated the Ore Knob /Williams Drive Emergency Response and Removal Action. Bottled water was provided to residents with significant exposure risk to contaminated groundwater. Whole house treatment systems were installed, repaired, or modified where source water was impacted by site-associated

contaminants. Residents continue to come forward and request drinking water well sampling by EPA. Annual treatment system sampling continues to identify problems with existing treatments systems. Bottled water continues to be provided to at risk residents as necessary.

In an extended investigation beginning in April 2010 and ending in June 2012, EPA SESD sampled wells, springs, and treated potable water in the vicinity of the site. One hundred forty nine potable water samples were collected and analyzed from 79 potable water sources consisting of 15 springs and 64 wells. Each water source sample was submitted for at least one full suite of analyses including metals, cyanide, SVOCs, pesticides, PCBs, and VOCs. Certain water sources, selected for proximity to historical mining operations, were analyzed for acidity, alkalinity, and sulfate. Any water system having a treatment system in place also had the treated water analyzed for metals to assess the efficacy of the treatment system. There were 15 wells found to have levels of metals exceeding site-specific risk-based levels (SSRBLs) for manganese at **880 µg/l** and the Maximum Contaminant Level (MCL) for cobalt at **11 µg/l**. Isolated levels of metals exceeding SSRBLs and MCLs also occurred in these 15 wells for beryllium, cadmium, copper, iron, and nickel. Maximum exposure point concentrations for manganese and cobalt are **Mn 18,200 ug/l** and **Co 160 ug/l.** These drinking water wells are located in the vicinity of the historical mining operations and to the Northwest of the flooded underground mine workings. The locations of the sampled sources in relation to the site are shown in the attached *Figure 1, Potable Water Source Locations*. The extent of mining operation impacts can be seen in a general sense in the attached *Figure 2, Water Source Manganese Levels*.

Specifically identify the discrete activities and site areas to be considered by this panel evaluation:

Under EECA Alternative 4, treated water from the City of Jefferson will be provided (for purchase) for consumptive use by residents affected by the site. Alternative 4 includes extending potable water service and limited fire protection from Jefferson, North Carolina to the Site. A margin of safety sufficient to cover additional properties should be included in the engineering design so that the water system would continue to function if additional hook-ups are required in the future. These include residents whose private drinking water wells have been impacted by the site and who reside within a buffer zone established by analytical results from private wells and best professional judgment. This buffer zone will allow for the protection of residential wells that may potentially be impacted by the Site in the future. The extension will require installation of a 12-inch main from the terminus of the Jefferson water main located approximately 7.5 miles west of the Site. This action will provide a water storage tank at sufficient elevation to provide water service to the community. The water line will extend along Highway 88 rights-of-way to Ore Knob Road. Water service to the two separate service areas will be provided by a 10-inch water line. A fire hydrant will be provided in each residential area for fire protection. Post removal site control will be managed by the town of Jefferson. The town of Jefferson has agreed to maintain the waterline extension when the action is complete. Components of this alternative include:

- Completion of an engineering design for the proposed public water supply extension from Jefferson, NC.
- Obtain required agreements, permits, permissions and approvals for construction and utility easement access.
- Extend the City of Jefferson, NC 12 inch water main along Highway 88 from its terminus to the Site.
- Provide a water storage tank at sufficient elevation to provide water service to the community.
- Provide contingency for additional engineering controls as necessary to prevent the accumulation of chlorohalomethane compounds in the supplied water.
- Extend an 8 inch line throughout service areas of the site.
- Install lateral connections, isolation valves and flow meters to each of the 15 residential parcels.
- Install one fire hydrant near each of the residential areas.
- Provide a new drinking water well and or permanent filtration at an outlying residence contaminated by a groundwater plume from the tailings pond.
- Continue to provide bottled water to all affected households that have contaminated residential groundwater supply wells until the municipal supply of potable water is established.

Briefly describe additional work remaining at the site for construction completion after completion of discrete activities being ranked:

RI / FS activities will need to be completed at additional OUs at the site. Primarily for Surface Water (OU2) to address the acid mine drainage impact to ecological surface water resources including a 1.5-mile length of Ore Knob Branch, a 2.25-mile length of Little Peak Creek, about 2.9 miles of Peak Creek, from its merging point with Ore Knob Branch to its merging point with South Fork New River, South Fork New River for some unknown distance downstream of Peak Creek. It is anticipated that both a large scale and a small scale acid mine drainage passive treatment system will be required to alleviate ecological risk at Peak Creek, Little Peak Creek and South Fork New River. RI / FS activities are anticipated for ground water (OU3) to further define the extent of the contamination plumes from the flooded underground mine workings as well as the 20 acre tailings pond. To a lesser extent RI /FS activities will be conducted to address contaminated soil at the various former operations areas at the site.

Response Action Cost

Total Cost of Proposed Response Action:

($ amount should represent total funding need for new RA funding from national allowance above and beyond those funds anticipated to be utilized through special accounts or State Superfund Contracts.)

The January 2015 Final EECA for Drinking Water estimated costs for Alternative 4, Municipal Water Supply were calculated for a moderate estimate and a conservative estimate. The total project capital cost for the moderate estimate is **$10,187,000**. The total project capital cost for the conservative estimate is **$13,994,400**.

Source of Proposed Response Action Cost Amount:

(ROD, 30%, 60%, 90% RD, Contract Bid, USACE estimate, etc…)

January 2015 Final Engineering Evaluation/Cost Analysis (EECA) for Drinking Water

Breakout of Total Action Cost Planned Annual Need by Fiscal Year:

(If the estimated cost of the response action exceeds $10 million, please provide multiple funding scenarios for fiscal year needs; general planned annual need scenario, maximum funding scenario, and minimum funding scenario.)

FY 2015 $9,329,600. FY 2016 $4,664,800. Conservative Estimate

Other information or assumptions associated with cost estimates?

Readiness Criteria

1. Date State Superfund Contract or State Cooperative Agreement will be signed (Month)?

Not Applicable

2. If Non-Time Critical, is State cost sharing (provide details)?

Not Applicable

3. If Remedial Action, when will Remedial Design be 95% complete?

Not Applicable

4. When will Region be able to obligate money to the site?

Summer 2015

5. Estimate when on-site construction activities will begin:

Fall 2015

6. Has CERCLIS been updated to consistently reflect project cost/readiness information?

SEMS will be kept up to date

Site/Project Name:	**Ore Knob Mine Site**

Criteria #1 - RISKS TO HUMAN POPULATION EXPOSED (Weight Factor = 5)

Describe the exposure scenario(s) driving the risk and remedy. Include risk and exposure information on current/future use, on-site/off-site, media, exposure route, and receptors:

At 15 private wells, total HI > 1 for adult and/or child exposure to Co, Mn, Fe predominates risk; Cu presents minor risk. Current and Future Resident exposure through ingestion of ground water, inhalation and/or dermal exposure while showering with groundwater. 30 year exposure period @ 350 days per year

- Child (1 to 6 yrs) – 6 year exposure duration
- Adult – 24 year exposure duration

Analytical results used for exposure point concentrations in the HHRA were the analytical results for drinking water well and spring samples collected in 2010, 2011, and 2012. Both untreated and treated water evaluated where point of entry treatment is being used. Of the 81 locations that were sampled (65 private wells and 16 springs), COPCs were measured in detectable quantities at 31 locations (29 private wells and 2 springs). Untreated ground water at fifteen locations (all private wells) was determined to have a potential for adverse health effects to residents with a non-cancer HI >1. The total cancer risk was below the threshold of concern for all lifetime residents. Some example well locations presented below:

Location	Who	Noncancer HI	COCs Contributing to Risk
OK702	Child	83	Mn > Co
	Adult	36	
OK706	Child	50	Mn > Co > Fe
	Adult	21	
OK707	Child	10	Co > Mn
	Adult	5	
OK708	Child	3	Mn = Fe
	Adult	1	
OK709	Child	43	Co > Mn > Cu
	Adult	19	

Estimate the number of people reasonably anticipated to be exposed in the absence of any future EPA action for each medium for the following time frames:

MEDIUM	<2yrs	<10yrs	>10yrs
Groundwater	0 – 40	➢ 40	➢ 40

Discuss the likelihood that the above exposures will occur:

Due to the high concentrations of manganese, iron and cobalt dissolved within the mine impacted ground water, existing whole house water softener treatments systems are expected to continue to fail at an unknown rate. The anion exchange media within the treatment system will clog and lose its effectiveness over time and experience breakthrough of contaminants as the anion exchange media is ultimately extinguished. This can only be positively established by analytical sampling after exposure has likely occurred. The treatment system would then require replacement. Additionally, we have repeatedly witnessed operator error by the residents that can also cause exposures to occur. Anion exchange water softener treatment systems are at best a temporary solution at these contaminant concentrations.

New residents are expected to continue to move into the area and ground water wells and springs are the only source of potentially potable water in the vicinity of the site. At least one new residence has been observed under construction

adjacent to the site within the last 6 months.

Other Risk/Exposure Information?

Site/Project Name:	**Ore Knob Mine Site**

Criteria #2 – SITE/CONTAMINANT STABILITY (Weight Factor = 5)

Describe the means/likelihood that contamination could impact other areas/media given current containment:

The total extent of the ground water plume impacted by the flooded undergrounds mine workings is unknown and uncontained. Considerable additional RI work will be required in order to try to determine its extent. The plume will likely continue to migrate.

Are the contaminants contained in engineered structure(s) that currently prevents migration of contaminants? Is this structure sound and likely to maintain its integrity?

No

Are the contaminants in a physical form that limits the potential to migrate from the site? Is this physical condition reversible or permanent?

No. The flooded Ore Knob underground mine workings contained iron sulfide minerals including pyrrhotite, pyrite, and chalcopyrite. When exposed to atmospheric oxygen and moisture, these minerals oxidize to produce acidity, sulfate, and metals that dissolve into the ground water. This process has contaminated ground water that has flooded the underground workings, creating a subsurface pool of contaminated water that has migrated to down-gradient locations. This physical condition is not reversible and considered permanent. The mine workings have been flooded for > 50 years.

Are there institutional physical controls that currently prevent exposure to contamination? How reliable is it estimated to be?

No

Other information on site/contaminant stability?

At least 2 rental residences (and potentially 4 when the trailers are rented) are drawing their water from a former air shaft to the mine. Four pumps are suspended at an unknown depth in the air shaft and service up to 4 trailers. Their water is tested annually and to date has not shown contamination by site related contaminants. It is postulated that shallow low total dissolved solid (TDS) groundwater is floating on the more dense high TDS mine water forming a chemocline (analogous to a halocline in coastal groundwater systems) between less dense shallow groundwater and the more dense high TDS mine water.

Site/Project Name:	Ore Knob Mine Site

Criteria #3 – CONTAMINANT CHARACTERISTICS (Weight Factor = 3)

(Concentration, toxicity, and volume or area contaminated above health based levels)

List Principle Contaminants (Please provide average and high concentrations.):

(Provide upper end concentration (e.g. 95% upper confidence level for the mean, as is used in a risk assessment, or maximum value [assuming it is not a true outlier], along with a measure of how values are distributed {e.g. standard deviation} or a central tendency values [e.g., average].)

Contaminant	*Media	**Concentrations
Manganese	GW	18,200 ug/l
Cobalt	GW	160 ug/l
Iron	GW	42,000 µg/L

*(*Media: AR – Air, SL – Soil, ST – Sediment, GW – Groundwater, SW – Surface Water)*

*(**Concentrations: Provide concentration measure used in the risk assessment and Record of Decision as the basis for the remedy.)*

Describe the characteristics of the contaminant with regards to its inherent toxicity and the significance of the concentrations and amount of the contaminant to site risk. *(Please include the clean up level of the contaminants discussed.)*

Contaminant of Concern	Range of Measured Concentrations in Untreated Ground Water	Basis for Removal Action Goal	Removal Action Goal
Cobalt	0.1U - 160 µg/L	Risk based HQ=1	11 µg/L
Copper	0.87 - 3,800 µg/L	MCL	1,300 µg/L
Iron	35.1 - 42,000 µg/L	Risk based HQ=1	26,000 µg/L
Manganese	1U - 18,200J µg/L	Risk based HQ=1	880 µg/L

Describe any additional information on contaminant concentrations which could provide a better context for the distribution, amount, and/or extent of site contamination. *(e.g. frequency of detection/outlier concentrations, exposure point concentrations, maximum or average concentration values, etc.....)*

The underground mine workings trend East-Northeast horizontally for at least 4,000 feet and to depths of more than 1,000 feet at the west end to depths of approximately 200 feet at the East end. The mine was flooded when it closed down in 1962. Ground water has flooded the underground workings, creating a subsurface mine pool of contaminated water that has migrated to down-gradient locations via fracture flow in a fractured bedrock aquifer. The current understanding of the site conceptual model is that shallow low total dissolved solid (TDS) groundwater is floating on the more dense high TDS mine water forming a chemocline (analogous to a halocline in coastal groundwater systems) between less dense shallow groundwater and the more dense high TDS mine water. The water below the chemocline is contaminated with acid, metals and sulfate. The majority of the most contaminated wells are located adjacent to and Northwest of the mine workings indicating a northwest flow of the contaminated water. Wells of sufficient depth that penetrate the chemocline are contaminated with acid and metals (Figure 3)

Other information on contaminant characteristics?

Site/Project Name:	Ore Knob Mine Site

Criteria #4 – THREAT TO SIGNIFICANT ENVIRONMENT (Weight Factor = 3)

(Endangered species or their critical habitats, sensitive environmental areas.)

Describe any observed or predicted adverse impacts on ecological receptors including their ecological significance, the likelihood of impacts occurring, and the estimated size of impacted area:

RI / FS activities will need to be completed at additional OUs at the site. Primarily for Surface Water (OU2) to address the acid mine drainage impact from the tailings impoundments to ecological surface water resources including a 1.5-mile length of Ore Knob Branch, a 2.25-mile length of Little Peak Creek, about 2.9 miles of Peak Creek, from its merging point with Ore Knob Branch to its merging point with South Fork New River, South Fork New River for some unknown distance downstream of Peak Creek. Contaminated ground water discharges to surface water in the vicinity of both of the tailings impoundments. It is anticipated that both a large scale and a small scale acid mine drainage passive treatment systems will be required to alleviate ecological risk at Peak Creek, Little Peak Creek and South Fork New River.

Would natural recovery occur if no action was taken? ☐ Yes ☒ No
If yes, estimate how long this would take.

Other information on threat to significant environment?

Site/Project Name:	Ore Knob Mine Site

Criteria #5 – PROGRAMMATIC CONSIDERATIONS (Weight Factor = 4)

(Innovative technologies, state/community acceptance, environmental justice, redevelopment, construction completion, economic redevelopment.)

Describe the degree to which the community accepts the response action.

The Ore Knob community members and the Town of Jefferson officials have been involved during the EE/CA process. Ore Knob community members have readily participated in the community involvement process and were present at the public meetings during the EE/CA process. EPA believes that the community supports the response action. Post removal site control will be managed by the town of Jefferson. The town of Jefferson has agreed to maintain the waterline extension when the action is complete. The Ore Knob Community Action Groups accepts EECA Alternative 4, Municipal Water Supply as well as the majority of the community members interviewed.

Describe the degree to which the State accepts the response action.

The State of North Carolina has been actively involved in the EE/CA Process and NCDENR supports the response action EECA Alternative 4, Municipal Water Supply.

Describe other programmatic considerations, e.g.; natural resource damage claim pending, Brownfields site, use of innovative technology, construction completion, economic redevelopment, environmental justice, etc…

Alternative 4 – Municipal Water Supply

- Community Acceptance – Community prefers Alternative 4 – Municipal Water Supply because it is permanent and effective long-term solution for residents with contaminated water
- Past and Future Expenditures – EPA spent $6.2 Million on Tailings Pond TCR; Future Expenditures to mitigate surface water impacts may exceed $10 million
- Ground Water - This decision significantly impacts future groundwater remedial decisions